

SYSTEM AND METHOD FOR FIBER OPTIC COMMUNICATION WITH SAFETY-RELATED ALARM SYSTEMS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority under 35 U.S.C. § 119(e) from provisional application number 60/437,951 filed 01/03/2003. The 60/437,951 provisional application is incorporated by reference herein, in its entirety, for all purposes.

FIELD OF THE INVENTION

[0002] This invention relates generally for alarm systems. More particularly the present invention is a system and method for monitoring safety related systems (SRSs) in a Secure Compartmented Information Facility (SCIF) that addresses concerns for security of electronic emanations from equipment in the SCIF.

BACKGROUND OF THE INVENTION

[0003] Radio frequency (RF)-shielded rooms and SCIF areas are primarily constructed and used by the military and the government to create secure areas where computing and various forms of communications can occur without those areas being susceptible to outsiders intercepting the secret information or communications occurring therein. Computers and other electronic devices create electrical emanations that can be transmitted over power lines, communications lines, and other electronic cables that are resident in a SCIF. As a consequence, communications and computations can be intercepted and interpreted.

[0004] RF- shielded rooms are constructed using steel (or copper) walls and electronic filters and re connected to power and communication cables to isolate the electrical emanations created by the computer equipment and communications equipment within the SCIF. Unfortunately, electronic filtering techniques that are used on incoming and outgoing power and communications cables prevent most types of fire alarm circuits and other two-way communication paths from properly functioning within SCIF's.

[0005] SCIF areas are also constructed to protect against speech conversations from being intercepted or heard outside the secure area. SCIF areas are also built to protect from speech conversations being "heard" by passive speaker circuits (such as public

address systems, fire alarm voice speaker circuits, and intercom systems). These small electrical currents can be intercepted on the system cabling outside the secure area and be amplified to actually “listen in” on the private conversations. Generally, speaker circuits for public address systems, intercom systems, and fire alarm systems are not built to prevent this compromise of voice information. If speakers having countermeasures were in place, they might not meet the requirements for audible alarm systems.

[0006] Thus, the regulations that allow a SCIF to be qualified to house classified operations are frequently at odds with meeting building code requirements for providing proper audibility of fire alarm signals in the secure areas of the building.

[0007] Fiber optical cabling offers a secure means of communication that is generally immune from electromagnetic interference and eavesdropping. While these qualities of fiber optical cabling have been exploited in the art, the use of such cabling to provide alarms in secure areas has not been addressed.

[0008] In U.S. Patent 4,161,650 issued to Caoutte et al., fiber optical cable is used to convert the output of a parallel electrical interface to optical digital signals, and to convert the optical digital signals back to parallel electrical signals at the receiving end. The fiber optical cable was identified as reducing cross-talk over copper circuits.

[0009] In U.S. Patent 4,596,049 issued to Rizzotti, digital control signals are sent over fiber optical cable between a plurality of remote stations and a local control station. The local control station monitors a device to be controlled and reports on its status to the remote stations. The fiber optical cable was identified as reducing EMI, particularly in control circuits used on ships.

[0010] In U.S. Patent 5,724,363 issued to Breya, a system and method for reducing system errors in an amplitude modulated optical signal transmission system is described. The invention is directed to calibrating a selected analog optical channel while transmitting on another analog optical channel.

- [0011] In U.S. Patent 4,839,527 issued to Leitch, a fire detection system uses fiber optics to detect communicate the presence of smoke, and to analyze the chemical composition of the smoke.
- [0012] In U.S. Patent 4,933,667 issued to Shaw et al., a graphic annunciator is described. In a preferred embodiment, the annunciator includes a plurality of light-emitting diodes arranged in a graphic representation of the protected area and a signal processor coupled with the light-emitting diodes for receiving and processing the data signals and for selectively actuating the light-emitting diodes in response thereto according to configuration data stored in memory. The data signals are preferably optical signals transmitted over a fiber optical cable.
- [0013] In U.S. Patent 5,999,094 issued to Nilssen, a multiconductor telephone and smoke alarm distribution system is described. In an embodiment at least some of the conductors are fiber optical cables with the state desire of attaining a high degree of electromagnetic separation.
- [0014] In U.S. Patent 4,533,834 issued to McCormack, a fire detection system using optical fibers to transmit flame signals from a plurality of remote monitoring stations to a central detection and analysis station is described. Light from the fibers being dispersed by a prism associated with the scanner to allow detection of the various spectral components of the dispersed light by light sensitive semiconductors. The detected spectral components are then compared to known fire signal signatures which include flicker rate and spectral content information.
- [0015] In U.S. Patent 4,174,149 issued to Rupp, a secure communications system is disclosed which utilizes an optical signal transmitted over a frangible optical fiber. An alarm signal is continuously transmitted from the information receiver site to the information transmitter site over the same optical fiber. Any attempt to penetrate the optical fiber for the purpose of intercepting the information transmitted therein causes the frangible fiber to shatter, thereby disrupting the alarm signal being received at the information transmitter site. The detection of this condition results in the immediate disabling of the information transmitter

[0016] What would be useful would be a system and method for securely communicating an alarm condition in a safety related system (SRS) occurring outside of a SCIF to the occupants of the SCIF and for securely communicating an alarm condition occurring in a SRS inside a SCIF to a location outside the SCIF. Such a system and method should provide for detection of the failure of an SRS within the SCIF.

SUMMARY OF THE INVENTION

[0017] An embodiment of the present invention is a system and method for securely communicating an alarm condition in an SRS occurring outside of a SCIF to the occupants of the SCIF and for securely communicating an alarm condition in an SRS occurring inside a SCIF to a location outside the SCIF.

[0018] It is therefore an aspect of the present invention to provide for the extension of circuits of various types into a SCIF.

[0019] It is yet another aspect of the present invention to provide for public address systems and alarms in SRSs to be extended into a SCIF without the potential for transmitting secure communications outside the SCIF.

[0020] It is still another aspect of the present invention to provide a fiber optic communication system to eliminate the radiating, or transmitting of secure information outside of a SCIF.

[0021] It is a further aspect of the present invention to communicate an alarm condition in an SRS occurring within the SCIF to a location outside the SCIF in a secure fashion.

[0022] It is yet another aspect of the present invention to provide means for detecting the failure of SRSs within the SCIF at a location outside the SCIF and the failure of the link between the SCIF and a monitoring station outside the SCIF.

[0023] These and other aspects of the present invention will become apparent to those skilled in the art from a review of the technical description contained herein.

[0024] An embodiment of the present invention is a system and method for securely communicating an alarm condition in an SRS occurring outside of a SCIF to the occupants of the SCIF and for securely communicating an alarm condition in an SRS occurring inside a SCIF to a location outside the SCIF. By way of illustration and not as

a limitation, an SRS comprises a fire detection system, a fire suppression warning system, a security breach system, a biohazard warning system, and an emergency medical warning system. As will be apparent to those skilled in the art, the present invention may be implemented with other warning systems without departing from the scope of the present invention.

[0025] In one embodiment of the present invention, an optical transmitter and an optical receiver are in communication over a fiber optic cable. The optical transmitter is installed outside of the SCIF and is connected to the host alarm system (i.e. the building alarm system). For purposes of this application, the host alarm system comprises without limitation fire alarms, smoke alarms, burglar alarms, and other SRSs common in the trade. Further, such systems may also comprise a visual circuitry such as closed-circuit video cameras and the like.

[0026] The optical receiver is installed inside the SCIF and is connected to interior speakers and strobe lights inside the SCIF. The optical receiver detects alarm conditions in SRSs within the SCIF.

[0027] The optical transmitter and the optical receiver each comprise fiber optic transceivers, power supplies, and audio conversion circuitry. In one embodiment of the present invention, the optical transmitter and the optical receiver operate on 24 Volts DC and each comprises a built in power supply and battery charger for providing battery back up.

[0028] In another embodiment of the present invention, the optical transmitter is connected to the building alarm speaker and converts any audio signal from that alarm system to an optical signal that is transmitted over a fiber optic media to the receiver (located inside the SCIF). The optical audio signal is then converted back to a line level audio signal for subsequent play over interior speakers inside the SCIF.

[0029] The transmitter also comprises a tone generator module that produces a tone signal. In an embodiment of the present invention, the tone signal is an audio signal of 100 Hz, but present invention is not so limited. The tone signal is combined with a line level audio signal derived from the building alarm speaker or other source. This combined signal is transmitted via the fiber optic cable to the fiber optic receiver inside

the SCIF. The tone signal is used to activate a tone-actuated relay in the SCIF. If the tone signal is interrupted for any reason, , the tone activated relay sends a trouble signal to an alarm signal generator. For example, and not as a limitation, if the fiber optic cable is link fails, a trouble signal is sent to the alarm signal generator. The alarm signal generator actuates SCIF alarm device to alert the occupants of the SCIF that a problem has occurred. If the tone signal is interrupted and the fiber optic cable link is intact, the trouble signal is also reported to the optical transmitter located outside the SCIF. In an alternate embodiment, the tone signal is delivered to a speaker system within the SCIF and the tone activated relay is in series with the speaker system input. In this embodiment, a failure of the speaker on the input side would also result in the issuance of a trouble signal. .

[0030] The optical transmitter also comprises an alarm monitor that receives and converts alarm signals from the optical receiver. For example, and not as a limitation, the optical receiver sends an alarm signal if it detects that the fiber optical link or the SCIF speaker is not functioning properly. The optical receiver also sends an alarm signal if the SRS within the SCIF detects an alarm condition within the SCIF. In one embodiment, the alarm monitor comprises contact pairs that are closed when an alarm signal is received. However, this is not meant as a limitation. As those skilled in the art will recognize, other means for receiving and converting the alarm signals may be used without departing from the scope of the present invention.

[0031] The optical transmitter also comprises the ability to monitor a building alarm device from a SRS and transmit a signal to the optical receiver. This allows an alarm system inside the SCIF to be activated when an alarm condition exists outside the SCIF.

[0032] The optical receiver, located inside the SCIF, receives audio signals over a fiber optic link from the transmitter. The receiver then converts the optical signals to the electrical signals for subsequent use. In one embodiment of the present invention, a line level audio signal is distributed to a speaker within the SCIF to provide an audible signal to those inside the SCIF. In one embodiment of the present invention, the audible signal may be an alarm signal. In yet another embodiment of the present invention, the audible signal may be a voice message.

[0033] The audio circuit in the SCIF is monitored through the optical receiver by a tone-activated relay for the presence of a tone signal. Loss of the tone signal (caused by a break in the fiber optic cable, the speaker wiring or other malfunction) causes the tone-activated relay to send a trouble signal to an alarm signal generator. The alarm signal generator creates an optical signal that is transmitted over the optical media to the alarm monitor within the optical transmitter. In an embodiment of the present invention, the alarm monitor closes normally opened contacts resulting in an alarm signal being generated. This alarm signal is used to report the alarm condition to the building alarm system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] **Figure 1** illustrates an overview of a system for securely communicating an alarm condition in an SRS occurring outside of a SCIF to the occupants of the SCIF and for securely communicating an alarm condition in an SRS occurring inside a SCIF to a location outside the SCIF according to an embodiment of the present invention.

[0035] **Figure 2** illustrate an optical transmitter as used in the system illustrated in **Figure 1** according to an embodiment of the present invention.

[0036] **Figure 3** illustrates an optical receiver as used in the system illustrated in **Figure 1** according to an embodiment of the present invention.

[0037] **Figure 4** illustrates an alternative embodiment of the optical receiver as used in the system illustrated in **Figure 1**.

DETAILED DESCRIPTION OF THE INVENTION

[0038] As noted above, the present invention is a system and method for providing alarm monitoring and notification in a SCIF. Signal emanation from the SCIF is avoided by converting electrical signals to optical signals as they are generated in the SCIF.

[0039] Referring to **Figure 1**, a system for securely communicating an alarm condition in an SRS occurring outside of a SCIF to the occupants of the SCIF and for securely communicating an alarm condition in an SRS occurring inside a SCIF to a location outside the SCIF according to an embodiment of the present invention is illustrated.

The fiber optic system comprises an optical transmitter **100** connected over an optical fiber link **125** to an optical receiver **130** inside the SCIF.

[0040] The optical transmitter **100** is connected to a building alarm device **110**, which receives a signal from a SRS **107**. By way of illustration and not as a limitation, an SRS **107** comprises a fire and smoke alarm system and a building alarm device **110** comprises a strobe and a speaker. While **Figure 1** depicts a single building alarm device **110** and a single SRS **107**, the present invention is not so limited. Any number of building alarm devices and SRSs may be used up to the capacity of optical transmitter **100**.

[0041] Any signal from the building alarm device **110** is transmitted to the optical transmitter **100** that converts the electrical signal received to an optical signal. That optical signal is sent over the fiber optic link **125** to the optical receiver **130**.

[0042] As noted above, when an alarm condition in the building exists, an electrical signal is converted to an optical signal by the optical transmitter **100** and sent over optical link **125** to the optical receiver **130**. The optical receiver **130** converts the optical signal to an electrical signal that is used to power a SCIF speaker **135** and/or a SCIF alarm device **155**. This allows personnel within the SCIF to be alerted to condition outside of the SCIF.

[0043] In yet another embodiment, when SCIF SRS **140** determines that an alarm condition exists within the SCIF, an alarm signal is sent to SCIF speaker **135** and/or SCIF alarm device **155**. The alarm condition is detected by optical receiver **130** and is reported over fiber optic link **125** to optical transmitter **100** where it is sent to the building alarm system (see, **Figure 2**).

[0044] In still another embodiment, a tone signal is generated by optical transmitter **100** is sent to optical receiver **130**. Optical receiver **130** monitors for the presence of the tone signal. If the tone signal is not present, an alarm signal is sent to the optical transmitter **100** and forwarded on to the building alarm system (see, **Figure 2**).

[0045] In an embodiment of the present invention, the optical receiver **130** inside the SCIF is also powered by 24 VDC from the building power and also comprises a battery back up **150** that provides 24 VDC during times of power failure. In another

embodiment, SCIF speaker **135** is a self-powered speaker. However, this is not meant as a limitation.

[0046] **Figure 2** illustrates an optical transmitter according to an embodiment of the present invention. The optical transmitter **200** receives information concerning a building alarm device **210** through the building alarm relay **205**. When an alarm conditions is present, the building alarm relay **205** is activated and an alarm signal is sent to an optical signal generator **225**. Optical signal generator **225** converts the alarm signal to a fiber optic signal for transmission to the optical receiver in the SCIF.

[0047] Speaker interface **220** interfaces between the building alarm speaker **215** and the optical transmitter **200**. Speaker interface **220** converts any present speaker signal to a low level audio signal for subsequent conversion to fiber optic signals. The low level audio signal is converted to an analog optical signal by optical signal converter **230**.

[0048] Tone generator **235** generates a tone signal that is used to assess the integrity of the fiber optic link **125** connecting the optical transmitter **200** and optical receiver **300** (see, **Figure 3**) and optionally the speaker circuit integrity within the SCIF (as more fully set forth below). In an embodiment, the tone signal is a 100 Hz signal, but this is not meant as a limitation. The tone signal is combined with the low level audio signal obtained from the speaker interface **220** and converted to an optical signal at optical signal converter **230**. The combined optical signal is sent via the fiber optic link **125** (see **Figure 1**) to the optical receiver **300** (see **Figure 3**) in the SCIF.

[0049] Alarm signals from the optical receiver are received by an alarm monitor **240**, converted from optical signals to electrical signals, and delivered to building SRS **250** for processing.

[0050] Optical transmitter **200** receives power from power supply **270**. In an embodiment of the present invention, power supply **270** is an Altronix AL400ULXB 24 VDC power supply, building alarm relay **205** is an Air Products PAM-1 relay, speaker interface **220** is a Radio Design Labs TX-70A speaker interface, and tone generator **235** is a Radio Design Labs T-OSC-2 oscillator. However, the present invention is not so limited. Other devices performing similar functions may be used without departing from the scope of the present invention. While **Figure 2** depicts a single building alarm device **210** and a

single building SRS 250, the present invention is not so limited. Any number of building alarm devices and building SRSs may be used up to the capacity of optical transmitter 200.

[0051] The only connection between the fiber transmitter and the receiver is via a single or dual fiber optic link 125 (see **Figure 1**). Such cables are known to those skilled in the art.

[0052] **Figure 3** illustrates an optical receiver according to an embodiment of the present invention. Incoming fiber optic signals are received at the optical receiver 300 and routed to an alarm signal monitor 315. The combined audio signal (if any) and the tone signal is converted to a line level signal and routed to tone-activate relay 305. The tone-activated relay 305 senses the tone signal generated by the tone generator 235 of the optical transmitter 200 (see **Figure 2**). The tone-activated relay 305 remains closed so long as the tone signal is detected. If the tone signal is no longer detected, the tone-activated relay 305 sends a trouble signal to alarm signal generator 310. An alarm signal is then sent SCIF alarm device 330 and to alarm monitor 240 over fiber optic link 125 (if operational) and then to the building SRS 250 (see **Figure 2**). In this way, a problem in the optical transmitter 200, the optical receiver 300, or the fiber optic link 125 may be detected and alarms sounded in both the SCIF and the location outside the SCIF.

[0053] Referring to **Figure 4**, an alternative embodiment of the present invention is illustrated. In this embodiment, the combined audio signal (if any) and the tone signal is converted to a line level signal and routed to a SCIF speaker 320. The tone-activated relay 305 is connected to a “return” speaker circuit. In this embodiment, a loss of the tone signal further suggests that a problem may have occurred in the SCIF speaker 320 or its associated wiring.

[0054] Alarm signal monitor 315 also processes alarm signals received from the optical signal generator 225 of optical transmitter 200 (see **Figure 2**). These signals are routed to a SCIF alarm device 330. By way of illustration and not as a limitation, the alarm signal is from an intrusion or fire detection system and the SCIF alarm device 330 is a strobe light and/or fire alarm speaker. In this way, an alarm condition in a SRS outside the SCIF can be reported to occupants of the SCIF over a secure optical fiber link.

[0055] A SCIF SRS **325** monitors the SCIF for an alarm condition within the SCIF. If an alarm condition is present, the SCIF SRS causes the SCIF alarm device **330** to be activated. The optical receiver determines when SCIF alarm device **330** is activated and causes alarm signal generator **310** to send an alarm signal to optical transmitter **200** (see **Figure 1**). In this way, alarm conditions within the SCIF are reported to a location outside the SCIF by secure means.

[0056] A power failure relay **350** is also present in the optical receiver. In the event of power failure in the SCIF, the power failure relay **350** causes alarm signal generator **310** to send alarm signal over fiber optic link **125** to the alarm monitor **240** and then to the building SRS **250** (see **Figure 2**).

[0057] Optical receiver **300** receives power from power supply **370**. In an embodiment of the present invention, power supply **370** is an Altronix AL400ULXB 24 VDC power supply, tone activated relay **205** is Radio Design Labs ST-VOX1 Voice Activated Relay, SCIF speaker **320** is a Wheelock SA-series self amplified speaker, and tone generator **235** is a Radio Design Labs T-OSC-2 oscillator. However, the present invention is not so limited. Other devices performing similar functions may be used without departing from the scope of the present invention.

[0058] While **Figure 3** depicts a single SCIF alarm device **330** and a single SCIF SRS **325**, the present invention is not so limited. Any number of SCIF alarm devices and SCIF SRSs may be used up to the capacity of optical receiver **300**.

[0059] By using a fiber optic system to connect external systems with in-SCIF systems, electromagnetic emanations from within the SCIF are minimized. Thus the present invention allows for normal alarm monitoring within the SCIF and alarm notification from outside the SCIF without compromising any classified work taking place within. It will be apparent to those skilled in the art that other variations of the present invention are possible without departing from the scope of the invention as disclosed.